

THE PULL OF HISTORY

Human Understanding of Magnetism
and Gravity through the Ages

This book seeks to understand what conceived modern physics by focusing upon the formation of the concept of force. This would be the first book to note the important role magnetism has played in this process. Indeed, the force between celestial bodies, before the introduction of Isaac Newton's gravitational force, is first introduced by Johannes Kepler by analogy with magnetic force. Moreover, this book, by concentrating our attention on magnetism, fully describes the developments and the recognition of the force concept during the Middle Ages. The detailed description of the Middle Ages and the Renaissance is a strong point of this book. By discussing and emphasizing on the role accomplished by the magnetic force, this book distinguishes the connection between the natural magic and modern experimental physics. This book will open a new aspect on the birth of modern physics.

World Scientific
www.worldscientific.com
10540 hc

ISBN 978-981-3223-76-9



9 789813 223769

Preface	v
Introduction	xi

Part 1 Antiquity and the Middle Ages

Chapter 1—Ancient Greece: The Science of Magnetism is Born

§1 Early Attempts to Explain Magnetism	3
§2 Plato and <i>Timaeus</i>	15
§3 Magnetism according to Plato and Plutarch	20
§4 Aristotle's <i>Physics</i>	25
§5 Theophrastus and Later Aristotelians	32

Chapter 2—The Hellenistic Age

§1 Epicurus and Atomism	39
§2 Lucretius and his Legacy	42
§3 Magnetism according to Lucretius	48
§4 Galen's <i>On the Natural Faculties</i>	54
§5 Galen and the Dispute over Magnetism	59
§6 Alexander of Aphrodisias	63

Chapter 3—The Days of the Roman Empire

§1 Aelian and Roman Science	72
§2 Dioscorides and <i>The Greek Herbal</i>	75
§3 Pliny and <i>Natural History</i>	81
§4 Pliny's Conception of Magnets as Living Creatures	86
§5 Sympathy and Antipathy in the Natural World	90
§6 Claudian and Aelian	97

Chapter 4—Christianity in the Middle Ages

§1 Saint Augustine and <i>The City of God</i>	103
§2 Forces Inherent in Natural Objects	108
§3 The Absence of Medical Theory in Christianity	112
§4 Marbode's <i>De lapidibus</i>	117
§5 Hildegard von Bingen	122
§6 Albert the Great's <i>Book of Minerals</i>	127

Chapter 5—The Discovery of Magnetic Directionality

§1 Medieval Society in Transition	134
§2 The Rediscover and Translation of Ancient Philosophy	139
§3 The Introduction of the Mariner's Compass	147
§4 The Discovery of Magnetic Directionality	154
§5 Michael Scot and Frederick II	157

Chapter 6—Thomas Aquinas and his Understanding of Magnetism

§1 The Structure of Knowledge in Christian Society	165
§2 Aristotle and the Discovery of Nature	168
§3 Saint Thomas Aquinas	173
§4 Aristotle and his System of Causality	178
§5 Thomas Aquinas and Magnetism	181
§6 The Heavens and their Effect on Magnets	186

Chapter 7—Roger Bacon and the Propagation of Magnetic Force	
§1 Roger Bacon and his New Perspective	195
§2 Bacon on Mathematics and Experience	201
§3 Robert Grosseteste	207
§4 Multiplication of Species according to Bacon	213
§5 The Propagation of Magnetic Force as Action through a Medium	218
Chapter 8—Petrus Peregrinus and his <i>Letter concerning the Magnet</i>	
§1 The Discovery of Magnetic Polarity	226
§2 Inquiries into the Nature of Magnetism	232
§3 Peregrinus's Methods and Aims	239
§4 The Social Context of the <i>Letter concerning the Magnet</i>	248
§5 Jean of Saint-Amand	254
Part 2 Renaissance	
Chapter 9—Nicolaus Cusanus and the Quantification of Magnetic Force	
§1 Nicolaus Cusanus and <i>On Learned Ignorance</i>	263
§2 Cusanus's Conception of the Universe	267
§3 The Importance of Number in the Understanding of Nature	273
§4 Cusanus's View of Magnetism	280
Chapter 10—The Rediscovery of Things Ancient: Magic in the Early Renaissance Period	
§1 The Revival of Magic during the Renaissance	284
§2 Foundations for the Spread of Magical Thought	291
§3 The Magical Thought of Pico and Ficino	295

§4 Magnetic Force as Magical Power	302
§5 Agrippa's Magic: Nature as Symbol	305

Chapter 11—The Age of Exploration and the Discovery of Magnetic Declination

§1 Magnetic Mountains	317
§2 The Magnetic Compass: Discovering the World	326
§3 Columbus and the Discovery of Magnetic Declination	334
§4 The Quantification of Magnetic Declination	341
§5 The Earth's Magnetic Pole: A New Concept	349

Chapter 12—Robert Norman and *The Newe Attractive*

§1 The Discovery of Magnetic Dip	357
§2 Norman's Observations concerning Magnetism	367
§3 The New Proponents of Natural Science	373
§4 Robert Recorde and John Dee	377

Chapter 13—Mining and the Continued Peculiarity of Magnetism

§1 The Cultural Revolution of the Sixteenth Century	385
§2 Biringuccio's <i>The Pirotechnia</i>	392
§3 Georgius Agricola	399
§4 Attitudes toward Alchemy	407
§5 Biringuccio's and Agricola's Understanding of Magnetism	412

Chapter 14—Paracelsus and Magnet Therapy

§1 Paracelsus	420
§2 Paracelsus's Medicine	428
§3 Paracelsus's Views on Magnetism	432
§4 Weapon Salve and Paracelsus's Posthumous Influence	438

Chapter 15—Changes in Magical Thought during the Late Renaissance

§1 Magic Sheds its Mysticism	447
§2 Pietro Pomponazzi and Reginald Scot	452
§3 Magic and Experimental Methods	458
§4 John Dee and the Mathematization of Magic	465
§5 Cardano: Magic and Electromagnetism	476
§6 Giordano Bruno's Understanding of Electromagnetism	482

Chapter 16—Della Porta's Investigations into Magnetism

§1 Della Porta's <i>Natural Magick</i> and its Background	491
§2 From Textual Magic to Experimental Magic	497
§3 <i>Natural Magick</i> and Experimental Science	503
§4 Overview of the Study of Magnetic Force in <i>Natural Magick</i>	506
§5 Della Porta's Experiments with Magnets	512
§6 Della Porta's Theoretical Discoveries	521
§7 Magic and Science	526

Part 3 The Dawn of the Modern Age

Chapter 17—William Gilbert's *On the Magnet*

§1 Gilbert and his Times	535
§2 Overview of <i>On the Magnet</i> and its Place in the History of Science	539
§3 Gilbert and the Founding of Electrical Science	543
§4 Gilbert's Explanation of Electric Force	549
§5 Iron, Magnets, and the Earth	554
§6 Concerning "Magnetic Motions"	560
§7 The True Nature of Magnetic Force and the Form of the Sphere	572

§8 The Motions of the Earth and Magnetic Philosophy	581
§9 The Magnet Earth and its Soul	590

Chapter 18—Johannes Kepler and the Magnetical Philosophy

§1 Kepler’s Starting Point	599
§2 Kepler’s Reformation of Astronomy	605
§3 Celestial Physics and “Moving Souls”	612
§4 Gilbert’s Theory of Gravity	618
§5 Gilbert’s Influence on Kepler	622
§6 Kepler’s Dynamics	631
§7 Astronomical Bodies as Magnets	637
§8 Kepler’s Theory of Gravity	643

Chapter 19—Seventeenth-century Mechanism and Notions of Force

§1 The Features of Mechanism	654
§2 Galileo and Gravity	658
§3 Cartesian Mechanics and Gravity	666
§4 Cartesian Mechanics and Magnetism	674
§5 Walter Charleton	685

Chapter 20—Robert Boyle and the Transformation of Mechanism in Britain

§1 Francis Bacon	694
§2 Thomas Browne	701
§3 Henry Power and “Experimental Philosophy”	705
§4 The “Corpuscular Philosophy” of Robert Boyle	714
§5 Mechanism and “Magnetical Effluvia”	721
§6 The Admission of Specific Operational Capacities.....	725

Chapter 21—Magnetism and Gravity: Hooke and Newton

§1 John Wilkins and Magnetical Philosophy	734
§2 Robert Hooke and Mechanism	742
§3 Hole and Gravity: The Break from Mechanism	747
§4 Measuring Gravitational Force and Magnetic Force	754
§5 Hooke's "System of the World"	759
§6 Newton and his Mechanics	764
§7 Newton and Gravitational Force	767
§8 Magic Sanctified	775
§9 Newton and Magnetic Force	779

Chapter 22—Epilogue: Ascertaining the Laws of Magnetic Force

§1 Musschenbroek's and Helsham's Measurements	794
§2 Calandrini's Measurements	799
§3 John Michell and the Inverse-square Law	805
§4 Tobias Mayer and the Demise of the Vortex Theory	810
§5 Mayer's Method of Magnetic Research	819
§6 Mayer's Theory: Hypotheses and Deductive Process	826
§7 Coulomb's Confirmation of the Inverse-square Law	830
Notes	845

Bibliography	893
---------------------------	------------